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LABORATORY OF SURGICAL RESEARCH, CENTRAL MEDICAL DEPARTMENT LABORATORY, AMERICAN EXPEDITIONARY FORCES, A. P. O. NO. 721, FRANCE.

To Brigadier-General J. M. T. Finney, M. C., U. S. A., Chief Consultant in Surgery, American Expeditionary Forces.

In accordance with your direction, an effort has been made to standardize procedures for the surgical treatment of thoracic injuries; first, by determination in the laboratory of the anatomical and physiological reactions fundamentally significant in repair; and, second, through the practical application of the principles thus established of the treatment of the wounded. The experimental work was done in the Laboratory of Surgical Research, and the clinical service was rendered in various hospitals of the forward areas reserved for the care of the non-transportable wounded.

It is impossible to submit a final report, because laboratory observations are incomplete and late clinical results are unavailable. An unexpectedly early disassociation of those engaged in this investigation has also made it impracticable to prepare illustrations, and to make proper acknowledgment of benefits derived from the work and writings of others.

Problem. Therapeutic methods were desirable to reduce the immediate and remote mortality; to extend effective surgical treatment to some of the more severely wounded, hitherto considered hopeless, and to secure an earlier and more complete functional recovery in a larger proportion of those convalescing from thoracic injuries. The requirements were a safe and simple method of performing thoracotomy; an operative technique for pulmonary repair that would provide immediate reinflation and reëstablishment of some degree of respiratory function, and, later, assure maximum pulmonary inflation and elasticity.

This problem consisted of the following factors:

1. Parietal repair—Primary healing must be assured.

2. Limitation of pleurisy—Reduction in intensity, extent, and duration.

a. Elimination of pleural irritation.

b. Determinate factors in pleural resistance.

c. Lung repair, preserving its elasticity.

d. Reinflation of lung—Reëstablishment of intrathoracic negative pressure.

e. Immobilization of affected side of chest.

f. Drainage with conservation of normal negative pressure.

3. Anesthesia—administration of nitrous oxide and of oxygen so as to control intrapulmonary pressure.

Experiments. An epidemic of rabies which occurred during the experimental stage made it imperative that all stray dogs be destroyed. The mayor of the city in which the laboratory was located gave his permission to use the animals that remained unclaimed at the pound for experimental purposes. The dogs were invariably operated upon in ether or nitrous oxide narcosis, and were protected against unavoidable distress by a free use of morphine before and after the operation. The facilities provided for this work by the Central Medical Department Laboratory and the Research Department of the Red Cross were so excellent that they would have been welcome in front area hospitals.

Parietal Repair. Failure to obtain air-tight parietal healing after thoracotomy leads to inevitable distress, frequently to death. Immediate and lasting union of the parietal pleura is more important than of any other structure. It is the surest protection against complete breakdown through extension of inflammation from without inward, or, more important still, from within outward. Opportunity for satisfactory repair is assured if the pleura be united surface to surface, as in intestinal suture, and if an adequate blood supply is provided by the avoidance of tension upon sutures.

Rib resection permits thoracotomy with the least damage from the standpoint of healing. After incising the anterior periosteum in the mid-line of the rib, it is carefully reflected so as to avoid injury to intercostal vessels or nerve. When the rib is resected a similarly placed incision in the posterior periosteum opens the chest. This loose periosteum, the inner reflection lined with pleura, immediately retracts and forms at the margins of the incision a welt of thickened tissue admirably adapted for holding sutures without interfering with essential blood supply. Contraction of the intercostal muscles, with respiration, produces immediate separation of wound edges after thoracotomy. These margins cannot thereafter be maintained in approximation without undue suture tension; consequently the ribs just above and below the incision must be brought abnormally close together. This rib approximation can be accomplished by passing a suture about them, and tying it with sufficient tension. Absorbable sutures, various types of catgut, and kangaroo tendon proved to be incapable of resisting this strain until there was firm healing. Silk, linen, and cotton are inferior to wire. Heavy silver wire, or that made from aluminum bronze alloy, proved to be satisfactory.

It is essential that mattress sutures be used in the pleural closure to guarantee surface approximation of the serosa. No rib denuded of its periosteum should be permitted to appear within the pleural cavity, as such potential foreign bodies lead to pleurisy or recurrent hemothorax. This is avoided by stripping the periosteum a short distance beyond the line where the rib is divided, and so placing the marginal stitches that the pleural pucker begins beneath and lateral to the rib ends.

Layer by layer the muscles and fascia are closed with interrupted stitches, so that they are accurately but not too snugly approximated. Because of the abnormal rib approximation there is some dead space to fill, but also, redundant tissue with which to fill it. The principle of imbrication variously applied serves this purpose admirably. At intervals these interrupted stitches should include the layer next below. This reinforces, prevents dead space, and, most important of all, limits the extension of infection. A separate closure of the superficial fascia is profitable.

Dogs are peculiarly susceptible to empyema. In a series of thoracotomies, this method of closure broke down only in consequence of extension from infected pleurisy, and when tension on the parietal pleural stitches, resulting from inadequate rib fixation, caused the parietal pleura suture line to give way. Similar observations have been made repeatedly at human necropsies, and indicated the necessity of guarding against this danger.

Limitation in Degree and Extent of Pleurisy. All foreign bodies are irritants, and all irritants in the presence of recent infection are undesirable. Blood itself is sufficiently irritant to the pleura to provoke a sero-fibrinous reaction. This reaction is sufficiently intense in the presence of hemothorax to unite the visceral and parietal pleura by fibrinous adhesions in the abnormal relationship consequent upon pulmonary compression and dislocation. Full blood is more irritating than defibrinated blood, which in turn is more irritating than blood serum. Fibrin could not be introduced intrapleurally without thoracotomy, which invali-

dated direct comparison. Almost certainly it is more irritating than full blood, hence the desirability of removing all the blood and coagula. Full blood coagulates in the chest in rapidity and in completeness directly proportionate to the degree of tissue injury, which determines the conversion of prothrombin into thrombin. Hemothorax induced with a minimum tissue injury, coagulates very slowly, because blood platelets and leukocytes degenerate slowly under conditions so slightly abnormal, which is a partial explanation for the belief that blood does not clot in the pleural cavity. Removal of other foreign bodies, bone, metal, bits of liver, etc., is even more essential. Flushing the pleura with solutions, saline, Dakin's solution, etc., gives an appearance of greater microscopic cleanliness, but reduces resistance to an extent that makes irrigation unjustifiable. Moreover, the slightest additional irritation to the pleura increases subsequent effusion.

b. Determinate Factors in Pleural Resistance. Area for area the healing reactions of the pleural and peritoneal serosa are histologically and physiologically similar, if not identical. The peritoneum is accepted as one of the best healing and most resistant tissues in the body; the pleura is known to have much less resistance. An anatomical and physiological comparison is illuminating.

The parietal pleura and peritoneum differ little in extent and in richness of blood and nerve supply. The visceral peritoneum is much greater in extent than the visceral pleura (the entire peritoneum is estimated at 98% of the skin surface), a material proportion of which is upon the omentum. Resistance to infection seems to be proportionate to the extent of the visceral serosa and the richness of its blood supply. It is impossible for dead space to occur intraperitoneally, and immobilization of intraperitoneal viscera can be made virtually complete with the administration of opium. The more complete the immobilization of the peritoneum in the presence of intraperitoneal irritation, the less the consequent effusion and diffusion, and the more rapid (4 to 6 hours) is the formation of fibrinous adhesions. These adhesions, inevitable in the healing of serous membranes, are desirable to protect local resistance.

The peritoneum has been shown to have the capability of exuding serum at the rate of 5% to 6% of the body weight an hour, and to absorb in almost the same rapidity. Under certain conditions intraperitoneal injections are virtually equivalent to intravascular. In the pleural cavity the potentiality for rapid effusion seems to be proportionately as great as the peritoneal, but the powers of absorption are much less. An amount of normal saline that would be taken up in a few minutes by the peritoneum may be shown with the aid of the fluoroscope to require 48 to 72 hours to disappear from the pleural cavity.

The three conditions precedent to smooth healing, elimination of irritation, physiological rest and increased blood supply are equally effective in promoting intrapleural resistance. It is because of the inter-dependence of circulatory and respiratory functions upon pleural integrity that its preservation assumes such great significance. Elimination of irritants needs no further discussion. Physiological rest cannot be made as nearly perfect intrapleurally as intraperitoneally, without affecting the even more important factor of circulation. Lung can be immobilized in two ways, by deflation or compression, and by inhibiting costo-diaphragmatic movements. Lung deflation is produced with some degree of pneumothorax, which means dead space and decreased resistance. Lung compression can be attained only by the presence of a foreign substance in the pleural cavity, and this, too, means decreased resistance. Both of these conditions cause pleural irritation and pulmonary deflation. Pleural irritation, in addition to causing increased effusion and pleural thickening, provokes inflammation in the adjacent lung parenchyma. This cortical pneumonia varies in degree and in extent with the duration and intensity of the pleurisy. It is prone to organization rather than to resolution, and the resulting increase in peripheral scar tissue is in part the explanation of the difficulty in securing subsequent pulmonary inflation. A possible explanation is the decrease or failure of pleural effusions to be absorbed. Protracted deflation causes a retraction of elastic tissue, vessels and nerves similar to the neuro-vascular-fascial contraction, consequent upon the fixation of joints in flexion. The blood supply to lung and pleura is proportionate to the extent of physiological inflation.

Experimental evidence indicated that pneumothorax so rapidly absorbed from normal pleura was slow to disappear in the presence of

an acute pleurisy. The effects of the introduction of various fluids intrapleurally were studied to determine the feasibility of a clinical application of this principle of immobilization of injured lung during the early period of healing. Normal saline was found to be the least irritating, and to be absorbed with desirable rapidity in 48 to 72 hours. However, where salt solution was put into the pleural cavity of thoracotomized animals, the parietal pleural suture line broke down in each instance. This was attributable to the force of respiratory and cardiac impulses transmitted through the fluid, and to the direct effect of the saline solution upon an adequate deposition of fibrin. Moreover, both of these methods produced increase in the rate and the distress of respiration. Inhibition of costo-diaphragmatic movements could with safety be induced in two ways. The rate and depth of respirations could be decreased with full doses of opium, which is effective when given in subtoxic amounts, by decreasing metabolism and consequently reducing oxygen requirements, with little or no depression of the respiratory centres under this condition. Or the diaphragmatic excursion could also be eliminated by blocking the phrenic nerve. It was found that injections of magnesium sulphate and of quinine and urea hydrochlorate were ineffective. Cocain was superior to novocain, in that less accurate infiltration of smaller amounts was effective. The resulting paralysis lasted from four to five days, and was succeeded by a gradual return of diaphragmatic function. The effect upon the diaphragm determined fluoroscopically was an immediate inhibition of contraction on the injected side. The only motion, and that very limited, was due to contractions from the contralateral side, transmitted through the central tendon. The relaxation of the paralysis permitted intra-abdominal pressure to raise the level of the diaphragm on the affected side, but insufficiently to cause serious pulmonary deflation. Diaphragmatic paralysis carried with it a decrease in costal excursion, so that the total reduction of intrapleural motion is considerable. These results were the same whether the phrenic was injected in the neck or in the chest, and no untoward results such as bronchitis or pneumonia were observed. This is precisely the mechanism that nature has developed in combating pleural pneumonia. When these principles were applied to thoracotomized animals, the beneficial effects were definite. A small group of dogs were not given morphine after operation. Their convalescence was less certain, longer, and the distress increased. A series in which the phrenic was injected showed a remarkable freedom from distress and a reduction in the amount of post-operative pleural effusion. Still more significant was their general condition on the fourth or fifth day, when the diaphragm resumed its function. This stage of convalescence corresponded to the tenth to fourteenth day in those animals subjected to identical operations, but in which no phrenic injection had been made.

In order that the three cardinal conditions upon which healing depends may be established after thoracotomy, the following precautions must be observed: Reduction in irritation by the least mechanical trauma; protection of the serosa against exposure and drying; preservation of lung elasticity; accurate pleural approximation; the establishment and maintenance of normal negative intra-pleural pressure; and the restriction of respiratory function for the first few days.

c. Lung Resection and Surgical Repair. Resection or deep incision of lung parenchyma must be made so that the resultant impairment of air and blood circulation will not interfere with possibilities of healing and of the return of function. Studies were made of the anatomy involved by injecting the bronchial and pulmonary arteries with a barium suspension, and then making radiograms of excised inflated lungs. Branches of the bronchi and pulmonary arteries were given off at nearly right angles to the parent stems near the hilus, but as the vessels extend toward the pleura, the angles of departure of the branches become progressively more acute. Physiological effects were determined by arterial and bronchial ligature in the living animal. Ligation of the bronchial artery causes atrophy of the part supplied, which on section shows a peculiar slatey pallor. Ligation of the pulmonary artery was followed by necrosis, which affected the periphery (pleural) primarily, and extended thence backward to the hilus, with a characteristic convoluted regularity of outline. Ligation of a bronchus to any lobe produced a purulent bronchitis, and later broncho-pneumonia with pleurisy. This was attributed to infection of secretions retained under pressure, due to interference with normal drainage. Ligation of very small bronchial

branches is productive of no serious consequences. A simple practical method of determining when an obstructed bronchus endangers the corresponding parenchyma is provided by the use of positive intrabronchial pressure. So long as the parenchyma can be inflated it is safe. An obvious danger of infection from the air and mucus forced through the severed bronchi was found experimentally to be neligible. A suspension of B. prodigiosus was insufflated intratracheally, positive pressure established, and subsequent culture taken from the bronchi after incising the lung—these results were negative. Lycopodium granules similarly insufflated could not be demonstrated upon incised lung surface.

The lung tissue up to the margins of surfaces to be united after operation must be viable and capable of function. Parenchymatous surfaces must be adequately approximated to insure healing without interference with function. Lung parenchyma is the equal of any tissue in the capacity for repair and for spontaneous hemostasis. All branches of the bronchial artery, distinguishable by spurting red blood under higher pressure, must be ligated. Also the larger pulmonary vessels should be tied. Several bronchial twigs are disclosed by the bubbles escaping from them, because of the positive pressure anesthesia described later. Those that are visible should be ligated.

Approximation of the lung surfaces must be achieved without producing avoidable induration from either the repair or from subsequent cicatrization, so that there may be little effect upon the elasticity of the organ. This closure must permit immediate lung function; the pleural surfaces must be in apposition for air-tight closure. These conditions prohibit the use of mass sutures. Fine stitches, as many as are required to give satisfactory approximation, are to be placed within the lung in full inflation. They should be placed superficially and tied just tightly enough to produce approximation. Surprisingly few are required to accomplish this closure. Pleural surfaces are to be united by a continuous mattress stitch of the Cushing type; this can be effected with little puckering, and with an air-tight suture line. When complete, one knot is the only foreign body exposed upon the surface.

d. Inflation of Lung to Reëstablish Normal Negative Pressure. Inflation of the lung during operation has essential advantages. It facilitates surgical manipulations by bringing the operative field nearer the surface, reducing thereby need for traction. Traction transmitted to the mediastinum is prone to produce an immediate and considerable drop in the systemic blood pressure. Inflation is the only way by which hemorrhage and escape of air can be controlled under conditions approaching the normal.

It is possible to inflate and deflate the lungs when the chest is opened without affecting the systemic blood pressure, because of the powers of compensatory adjustment in the rate of flow, amount and distribution of blood in the pulmonary circulation. Inflation up to normal limits does not apparently throw an increased burden upon the right heart. Air-tight parietal closure, while the lung is thus distended, permits an immediate reëstablishment of approximately normal negative intrapleural pressure, since the residual pneumothorax is so limited as to be negligible.

c. Immobilization of Affected Side of Chest. Injury alone suffices to restrict costal excursion upon the side involved. If the injury be severe enough to provoke pleurisy, hemorrhagic or serous, there may be also a limitation in the diaphragmatic excursion. This reflex reduction in motion can be supplemented but little by the use of pressure bandage. A snug bandage has good effect upon the wound healing. If immobilization of greater degree is desirable it can be attained by posture and by nerve block.

f. Drainage. Experiments on the treatment of infected pleural injuries simulating war wounds had just been started when orders came for duty in the forward area. The principles, but not the means of drainage, had been determined. An acceptable drain must be inserted in the costo-phrenic sinus so as to offer no obstruction to full pulmonary inflation, and where the consequent pleural reaction would be least harmful. It must permit air-tight insertion, and have a simple automatic one-way valve. This method would protect the degree of inflation and negative pressure obtained at operation, and tend to increase both if they were subnormal. Thus it would be applicable both in primary and secondary drainage, and when inserted with positive pressure anesthesia make feasible free drainage of early empyema before adhesions were present. Ultimately a satisfactory means was devised. An "L"-shaped piece of glass tubing 12-15 m.m. in diam-

eter, with its arms 3-4 cm. long, was completely covered by thick rubber tubing. The rubber tubing was cut flush at one end, and here the flat valve from a box respirator was slipped over and securely tied in place. The rubber tubing extended beyond the other end far enough to reach the level of the crest of the diaphragm and prevent occlusion.

A short low rib resection permitted this tube to be inserted with the end from which the rubber tubing projected on the inside, and turned upwards. Air-tight layer closure that lasted for four or more days, was easily accomplished. This simple apparatus fulfilled requirements already given, and under conditions that reduced individual attention to post-operative patients almost to the vanishing point.

g. Anesthesia. A simple method of giving nitrous oxide and oxygen, utilizing tank pressure, to secure needed degree of inflation, was devised by Captain Gwathmey. A full pre-operative dose of morphine made possible the induction of deep analgesia, without increasing the nitrous oxide and oxygen rates above 3 to 1, which Lieutenant-Colonel Cannon's experiments had proved to be the limit of safety in the presence of shock. Lieutenant Cattell's observations had indicated that morphine thus given had value as a prophylactic agent against on-coming shock, and therapeutic value when given early in the presence of shock. No untoward result from depression of the respiratory centre was noted.

Animal experiments showed clearly that administering anesthesia under tension, particularly when the chest was opened, was dangerous if the gas or ether was given in increased concentration. It also demonstrated that thoracotomy with all incidental manipulations, such as dislocation and operation upon lungs, could be performed under the primary stage of anesthesia. Manometric observations showed that when the pressure present in the mixing bag reached 8-16 m.m. Hg. it sufficed to distend the lungs completely. That degree of pressure is present when the bag fluctuated little during inspiration. Since this degree of tension in the bag produced an intrapulmonary pressure that was well within the limits of safety for dogs, the manometer was not deemed a necessary adjunct for human use.

A safe sequence in practice was found to be as follows: After the effect of the pre-operative hypodermic of morphine was present, administrations of pure oxygen under no tension were started. Then very gradually the pressure was increased, and the administration of nitrous oxide started. Rapidity of induction of the anesthesia was undesirable. Avoidance of excitation and the producing of gradually increasing inflation were essential. During the operation the proportions of the gas-oxygen mixture and the pressure transmitted to the trachea were varied to meet conditions. After the parietal pleura was closed the amount of nitrous oxide was gradually reduced; last of all, oxygen under pressure was continued until the patient was conscious.

The American Red Cross nitrous oxide apparatus perfected by Captain Gwathmey and adopted by the Army, fulfilled every requirement. This apparatus provides a mask that can be rendered relatively air-tight by close approximation to the face, an escape valve, a mixing bag close to the inhaler, and a rough gauge for estimating the proportion of the gases.

Intrapulmonary pressure was raised by increasing the rapidity of the flow of gases from the tanks, and by increasing the pressure upon the face piece. It was lowered by decreasing the rate of flow of the gases or by releasing the valve or decreasing the pressure which held the face piece in place. Thus, any degree of desirable inflation or deflation was promptly available to meet operative requirements. In general the degree of pressure utilized was that best suited to the animal or man under operation.

This method gives all practical requirements for intra-thoracic surgery without necessitating deep anesthesia for the introduction of intratracheal or endopharyngeal tubes. Moreover, its safety and ease of control has removed the chief obstacle to a wider application of surgical therapy.

h. Practical Application. So closely related is the physiology of man and dog, in spite of the gross anatomical differences in the pleura and mediastinum, that the principles established experimentally were directly applicable to the wounded. The human chest and lungs are far easier to manipulate, and more resistant to infection. Methods had to be varied to meet conditions, but, so far as was determined, there was no change in principles indicated from the end results.

Granted proper facilities, satisfactory triage, early transportation, and a trained personnel, 100% of chest wounds demanded surgical treat-

ment *but not necessarily thoracotomy*. This radical statement is made from the standpoint of the wounded individual, and takes no account of battle conditions and the requirements of evacuation. It is based upon the following facts: Experience has demonstrated the impossibility of eliminating bone injury without exploration in through-and-through bullet wounds of the chest, for example. Under the analgesia described it is easy to follow a bullet tract down to the entrance or exit from the thoracic cavity. Not infrequently an unsuspected rib fracture, even complete and comminuted, is disclosed. Further investigation, even when an unbroken but perforated rib was presented, will commonly show that the inner compact portion of the rib has been splintered, loose fragments driven into the lung or attached fragments into the pleural cavity. Such injuries may be accompanied by an inconsiderable amount of hemothorax, or it may develop that an injured intercostal artery is accountable for the bleeding. Since the pressure in the systemic circulation is six to eight times higher than it is in the pulmonary circuit, and the spontaneous control of bleeding in the thorax has been developed to combat the lesser pressure, an accurate control of such hemorrhage is of utmost importance. Surgical treatment of these lesser injuries is simple; some rib resection is indicated. The positive pressure will have returned the wound in the lung close to the parietal wound, through which it can be examined. If the lung injury be considerable, enough rib must be resected to give sufficient room to repair the lung damage. If it be a dry puncture, it may be disregarded as the positive pressure would have started anew bleeding from any dangerous source. If the lung hole be bleeding, it can be readily closed with a purse string suture of the visceral pleura, after gently withdrawing a cone of lung through the parietal opening. Should the injury to the parietes and to the lung be slight, and the hemothorax considerable, the uncoagulated portion of the latter can be removed by introduction of the aspiration nozzle (to be described later). The orifice of entrance or exit which gives the best approach should be used. After the lung is allowed to collapse a fairly saisfactory baling out is made possible. If the patient be in a dangerous condition, the irritation from the clots which remain may be compensated for by the saving of time, and manipulation, attendant upon a more radical operation.

The wound of exit should also be explored, because of the danger of rib damage. Here, too, for no evident reason, bone fragments can be driven backward into the lung.

Three means of parietal closure can be employed. If a considerable opening has been made, a routine closure, with rib stay of wire, is indicated. If the parietal opening be less extensive, visceral pleura may be stitched into the defect, or the same may be plugged with a transplanted muscle surface. In any case, the closure should be air-tight, and the last sutures tied, after full inflation is attained. Experience has shown that injuries thus treated repair well, and that parietal debridement of even bullet wounds is not contra-indicated. A large hemothorax and hemopneumothorax of unusual proportions demand radical treatment, though caused by through-and-through bullets without bone involvement. A large hemothorax provokes serious pleural reaction and pulmonary compression. Immediate aspiration is contraindicated, because fresh bleeding may result, and because part of the blood and all of the clots will fail of removal. Immediate intervention is indicated for reasons previously given. Large pneumothorax indicates the possibility that a large bronchial branch has been opened, and the danger of empyema from such a source.

The preceding groups may comprise 40%, or even more, of the chest injuries, depending upon the type of conflict. If to them be added groups of similar injuries produced by small shell fragments, they will together comprise those deemed by many as best treated expectantly. This conservative opinion is the result of the dangers attendant upon thoracotomy performed with open methods of anesthesia, or without the use of nitrous oxide as above described. There is a group of very grave chest injuries that during the stress of battle must be denied surgical treatment. During periods of less pressure these patients should be given every chance of recovery offered by operation, even though there is reason to question the probability of immediate survival.

Again, the analgesia from nitrous oxide and oxygen is the big factor, so little is the distress it causes. If surgical intervention offers the faintest chance of recovery, improbable by expectant measures, the individuals deserve the

chance. The fetish of statistics, and particularly the immediate mortality rate, has had too great an influence upon the attitude of clinicians functioning as medical officers. The recovery of no individual should be jeopardized by wanton surgery, but, on the contrary, every service should be rendered by giving even the worst risks any chance operation may offer.

There is another group made up of those having sucking wounds, large retained foreign bodies, liver injuries, and obvious compound fracture of the ribs and scapula that indisputably are suitable for surgical treatment. The methods of operating upon individuals showing such injuries can be divided into two types.

When the parietal wound is so severe that its treatment is going to contraindicate any further intervention, or when the intrathoracic injuries can best be approached through that pathway, adequate rib resection should be made at such a site. This method of approach has distinct advantages. It obviates additional incisions, leads directly to a part at least of the intrathoracic damage, reduces the duration of operation, and eventually reduces the total adhesive pleurisy by bringing the parietal wound only in contact with the visceral. It has the disadvantage, if the wound be high, low, or near the median line anteriorly or posteriorly, of restricting the field of intrathoracic exploration. Further, the tissues about the incision are bruised and infected, and cannot be expected to heal ideally. Neither can the deep closure of such a wound be entirely satisfactory. Unfortunately, this method is demanded in a considerable proportion of the severely wounded.

A more satisfactory method is to excise and repair the projectile wounds according to the methods indicated in the discussion of through-and-through bullet injuries. The chest is then opened by an incision placed ideally; or the thoracotomy may be performed first, and the results of the intrathoracic examination would determine if more need be done.

A section of the fourth rib, long enough to provide space for an easy insertion of a closed hand, should be removed from its postero-lateral aspect. This resection can be effected without cutting across muscle fibres that will be needed directly in closing the deeper wound. The latissimus dorsi can be drawn backward, and the pectoralis major drawn forward, after dividing its inferior lateral fibres close to their attachment, to secure adequate relaxation. The serratus magnus can be split between its fibre bundles. The opening thus obtained will allow inspection or palpation of the entire cavity, unless there are extensive adhesions. No mechanical rib spreader is needed, and should not be used, as such instruments crush the intercostal muscles, and interfere with the blood supply to the pleura. Additional exposure can be obtained only by rotating the third and fifth ribs. This rotation is best accomplished by lifting directly upward with broad bladed abdominal retractors.

With this exposure it is possible to operate on virtually any part of non-adherent lung. After partial deflation a lobe can be grasped with a Tuffier forceps, guided towards the opening in the chest wall, and made to present therein without traction simply by increasing the degree of inflation. If a diaphragmatic injury is suspected, resection of the fifth rib will make its repair possible. After such an operation an accurate closure is easy, and the healing satisfactory.

Experience in taking care of the wounded taught other principles worthy of record. Skin incisions should not be made completely at first, unless there is little doubt about the deeper injuries. When these have been determined through an incomplete incision, the balance can be adapted to circumstances. As a rule, simple, straight incisions are the best. At times flaps must be reflected, as the skin and fascia may be the only covering that can be provided for the pleural closure, which in itself may be incomplete.

In general, muscle splitting methods comparable to the gridiron incision for appendectomy, are most satisfactory. In this way debridement of successive layers can be done, cut muscle bundles kept distant from the site of injury, and smooth muscle surfaces preserved for final approximation. It is well to remember that recovery cannot take place without parietal healing, and parietal healing can occur after considerable bruising and soiling, even if a very extensive debridement is omitted. This applies even to the erector spinae group of muscles.

Bone injuries are handled with greater difficulty. Ribs may be resected at will, and should be sacrificed always to give proper approach, and at times to permit of better closure. Spinal injuries, if the cord is intact,

should be treated as any other compound fracture; converted, if possible, into a simple fracture by primary suture. If there is a cord lesion present only sucking wounds should be operated, and these only to secure parietal healing. Scapula may be tilted, or resected, leaving as much periosteum and margins for muscular attachments as conditions permit. The parietal pleura must be protected. A hole in it is about as easily repaired as a hole in a drum head, and there is about the same facility in its mobilization. Defects that cannot be repaired without tension should be filled either by stitching visceral pleura to the margin, or, if low enough, suturing to the diaphragm. If this is not possible, a smooth muscle surface should be applied.

When access to the thoracic cavity has been obtained, it is wisest to remove free blood at once, to prevent any further clotting. Any form of suction apparatus suffices. There should be a glass or metal tube long enough to reach any part of the chest, and having its distal end covered with a coarse wire bulb to prevent pleura and large clots from plugging the intake. Just before closure, all the clots and excess fibrinous exudate should be removed with gauze, if this is impossible manually.

Foreign bodies must be removed unless embedded in ribs, so that extraction requires another procedure unwarranted by the patient's condition. It is particularly essential to extract projectiles from the mediastinum, or when they are in close contact with large vessels.

Lung wounds may be closed safely with less resection than similar injuries to other tissues, because of the exceptional powers of resistance and repair of this organ. More than a slight trimming of shaggy margins should be reserved for those instances in which the blood and air circulation are irrevocably impaired. This presents the most difficult question to decide in the chest problems. When does hemorrhagic infiltration cease to be a recoverable lesion and amount to hemorrhagic infarction? Some lungs in which this infarction had been suspected to have occurred were resected, and recovery followed. In other patients partial lung resection, followed by death, failed to show at autopsy that the resection of itself had contributed to the fatality. In no instance where resection was absolutely indicated by the anatomical condition, and prevented by the general condition, did a survival occur. These fatalities were associated with a particularly virulent empyema. Only a little less baffling was the question of collapse. A part of the lobe, usually the lower, would be found atelectatic. The associated injury was generally severe and involved outlying ribs. Such a collapse could not be inflated during operation. None such was resected, because of depressed general condition. All that were recognized died. At autopsy the same portion was still collapsed, the balance of the lung slightly emphysematous, and an empyema was present. Apparently, the pleura overlying the segment of such abnormal lung ceases to function defensively if it has not become an actual foreign body.

Adhesions should be severed or torn only when necessary to make urgent repair. The tissue thus exposed is little resistant. All of these perforated chests are infected. The control of purulent pleurisy depends entirely upon the defense of the tissues exposed upon pleural surfaces. Chronic pulmonary emphysema sufficient to prevent normal deflation so reduces pulmonary circulation as to impede healing of lung parenchyma, and to lower pleural resistance. Foreign bodies in the lung parenchyma should be removed if the risk is not too great. All rib fragments should be removed, as the most dangerous factor in producing subsequent inflammation. Bullet and shell fragments larger than a few mm. in diameter can usually be palpated, and easily extracted.

The larger the bronchial branch that is opened, the greater the danger of infection, particularly when there is already access from the mucosa to the pleura. If such an opening cannot be made air-tight, it should be sealed with a pleural graft.

Injuries to the diaphragm are readily repaired. Liver injuries introduce bile into the pleura, where it is more harmfully irritant than in the peritoneum. The same sutures that reunite a torn diaphragm can be made to unite, or at least to fix the liver laceration. Transpleural drainage works beautifully where it is not needed. Injuries to other abdominal organs may at times be repaired by enlarging the left-sided diaphragmatic defect.

Primarily, drainage is indicated in the presence of an established pleurisy, particularly where it is associated with a liver injury, and consequent bile irritation, or with irritation resulting from

urine which has seeped into the chest from renal laceration, and when complicated by a sucking wound of many hours duration. It is also probably safer to drain at operation, when wide resection or extensive collapse make impossible an elimination of pneumothorax, and when there is reason to doubt the viability of lung or pleura. It must be remembered that whereas drainage of the general peritoneal cavity is impossible, drainage of the pleural cavity is feasible and safe, if properly done. The old dictum, "when in doubt, drain," as applied to the peritoneum, came to be, "when in doubt, don't drain." It is quite possible that the reverse may prove to be the outcome in the pleural cavity.

Indications for secondary drainage will be considered in the discussion of post-operative treatment.

i. Pre-operative Treatment. An individual with a chest wound is particularly in need of physical and psychic rest. This can be provided by an early administration of a full physiological dose of morphine (one-third to one-half grain). Other benefits to be derived from this drug have been enumerated.

Care of the wound includes accurate hemostasis, particularly of the intercostals. Suckers should not, as a rule, be provisionally sutured. Such a suture may lead to a considerable emphysema, with consequent reduced resistance in the tissue about the wound, may give a false sense of security, which lends to delay in operation, and assures some degree of pulmonary deflation. Unless there is a brisk uncontrollable hemorrhage from inside the chest, it is better to apply a large pad to the chest wall, completely covering the wound, fix it in place with adhesive, and then place a firm bandage, or a swathe, about the thorax. Besides decreasing distress, such a dressing acts as a suction valve, permitting the egress but not the ingress of air, and, by encouraging inflation, protects the pulmonary circulation.

Uncomplicated chest wounds are notably unlikely to foster shock. On the other hand, they are frequently productive of a high venous pressure, resulting from disturbed pulmonary circulation. Therefore, when shock is present, any intravenous injections must be given with special care not to overburden an already embarrassed right heart. Particularly important is a determination of the venous pressure under these conditions. If possible, transfusion should be done after pulmonary inflation has been established with the positive pressure of the anesthetic. Even when there is no shock, if there be a large hemothorax, a blood transfusion is indicated when hemostasis is accomplished. A grave anemia may be masked by an unusual distribution of blood, because of compression of the pulmonary circulation.

j. Diagnosis and Classification. Physical and fluoroscopic examination furnish fairly accurate data from which to determine urgency of operation. Projection of the wounds of entrance and of exit, or of the wound of entrance and the location of a retained missile (unless it was free in the pleural cavity) gave the course of the projectile approximately, and identified the structure probably involved and to some extent indicated the degree of damage. Especial care was taken in attempted determination of the presence and nature of bone injury. Urgency of operation as an immediate life-saving procedure is primarily to be considered, but ultimate functional recovery is also a factor in the following classifications:

Group 1. *Hemorrhage.* This group includes those suffering from the acute anemia of recent hemorrhage, and those who are still bleeding. Measures to be adopted must include immediate hemostasis, the safe-guarding against secondary hemorrhage, blood transfusion, and, when possible, repair according to established principles.

Group 2. *Sucking Wounds.* If conditions permit, this type should be treated like any other chest injury, plus closure of the parietal defect. Otherwise, simple closure, or a closure plus primary drainage, is demanded for immediate safety, relegating other measures for the future to determine.

Group 3. *Bone Involvement.* Every penetrating chest wound should be explored down to the pleural wound. Bone fragments are the most dangerous foreign bodies to both pleural and pulmonary healing, immediate and remote.

Group 4. *Pneumothorax.* This, uncomplicated, is rare, and due to injury of a large bronchus. Closure of this defect is demanded to prevent lethal complications.

Group 5. *Hemothorax of Symptoms.* Those of this group suffering from acute anemia have been considered in Group 1. The balance show respiratory and circulatory embarrassment due to pressure. As a rule, they have better chance of recovery if given immediate surgical care.

permitting accurate hemostasis and repair of visceral injuries.

Group 6. *Foreign Bodies.* The presence of a foreign body is sufficient to indicate operation for its immediate removal when it is large (and then there will usually be additional indications), when it is in close proximity to vital structures, or when lying free in the pleural cavity. All foreign bodies should be removed incidentally to operations for other reasons, when this is compatible with the immediate safety, and if the removal requires no manipulations that will impair functional recovery.

Group 7. *Hemothorax of Signs.* Simple hemothorax without symptoms. If limited in amount it should be treated expectantly, until there develops signs of infection or a rapid increase in amount, when radical treatment is indicated. If the hemothorax is large, and particularly when dense clots are demonstrable fluoroscopically, radical treatment promises earlier and more complete recovery with slight, if any, increased danger. A decision as to the treatment to be given to moderate sized hemothorax must depend on many factors, preference being given to conservatism.

Group 8. *Through-and-Through Chest Wounds* from bullets, without any of the previous indications, or similar wounds from small shell fragments are usually non-operative types, under ordinary conditions, and always under battle pressure.

k. Post-Operative Care. From a functional standpoint the first 48 hours following thoracotomy under positive pressure anesthesia contrasted most favorably with those performed under open ether. Dyspnoea and distress were vastly reduced, and post-operative shock cut to a minimum. Indeed, not infrequently the patient left the table in better condition than before operation. The degree of functional return effected by the elimination of post-operative pneumothorax contributed largely to this result. Further limitation of post-operative effusion, reduction in the incidence of pneumonia, and elimination of contralateral pulmonary collapse were remarked. These cases were observed for four to twelve days, but unfortunately, under existing circumstances, the end results could not be determined.

Morphine, by reducing the respiratory rate, and by affording rest, is a prime requisite in the post-operative treatment of chest wounds. The dosage must be guided by the condition and reaction of the individual. The indications of its efficacy are freedom from cough, pain, and distress.

Posture is an over-rated point in post-operative treatment. Any position producing a lateral curvature of the spine, with the concavity toward the affected side, will lessen the extent of respiratory movement on this side. The simplest means to produce this end, pillows, etc., are sufficient. The degree of elevation of a patient depends entirely on his condition and comfort.

Post-operative effusion inevitably consequent upon thoracotomy may be met by one or two divergent plans of treatment. The dry method attempts to keep the pleural surfaces in continuous contact by repeated aspiration. This facilitates the formation of adhesions and hastens a return of lung function. Such a plan is impracticable in field work, so that the expectant plan was followed. Pressure signs, or signs of infection of the effusion, were the primary indications for aspiration. An argument for this plan lies in the rest afforded by splinting the lung and restricting diaphragmatic excursion in the early period. Pleural effusions do not assume recognizable proportions until the second day, so that for this period pleural resistance is not materially affected by the presence of the fluid. The secondary indication for aspiration is the failure of this fluid to be absorbed.

Early return of the maximum degree of pulmonary function is an important feature in post-operative treatment. Neither active nor passive lung exercise should be attempted until the patient is afebrile. If, when begun thereafter, they are followed by recrudescence in temperature, such exertions should be discontinued until the patient is again afebrile. Measures involving some degree of personal attention or interest, such as blowing exercises, or the simple expedient of cutting down the respiratory rate to a minimum (by a watch) promises the greatest degree of success. Inconclusive observations on the use of positive pressure attained by giving oxygen through an anesthetic inhaler in this stage of the post-operative care were made. Exercises bringing into play the muscles of the thoracic cage should be introduced as soon as the patient is able to get out of bed.

l. Complications. Post-operative pneumonia is commonly contralateral and of the lobular or

bronchial type. Infrequency of its occurrence in this series obviously has some relation to the use of positive pressure and of gas and oxygen in anesthesia. It is possible that the inordinate respiratory effort induced by post-operative pneumothorax of the open method of anesthesia predisposes to, or actually excites an insufflation pneumonia. The treatment of this pneumonia is largely supportive. Cold air is contraindicated, unless the patient's condition be particularly robust.

Contralateral collapse did *not* occur in this series. Positive pressure was probably effective in eliminating this complication.

Post-operative empyema bears a definite relationship to the nature and condition of the wound, and its duration before operation. The condition of the pleura at the time of operation is of great prognostic value. A shaggy, fibrinous exudate, or a dirty pleura, argue against an uncomplicated convalescence. The incidence of empyema in patients operated upon later than 24 hours after the receipt of the injury, mounts very rapidly. A sudden increase in the fluid level, the patient's condition, together with signs of sepsis, and the bacteriologic and microscopic study of fluid removed by exploratory puncture, all determine the final diagnosis of empyema. If the organism be staphylococcus or pneumococcus, and if the patient's condition be good, repeated aspirations are permissible and often suffice. In the presence of streptococcus empyema, or that due to members of the anaerobic group of bacteria, immediate drainage is desirable.

Post-operative empyemas are productive of limiting adhesions in inverse ratio to the virulence of the causative bacteria. Consequently, the urgency for drainage is overbalanced by the contraindication of pulmonary deflation, unless some positive pressure anesthesia be employed and a suction type of drainage introduced. Using such methods, immediate secondary drainage can be established with a diagnosis. It must be remembered that under field conditions, close individual attention is impossible, and repeated aspiration, as in civil practice, cannot be performed.

m. Wound Healing. When fairly good surgical technique is possible, primary sutures of chest wounds give better results than wounds of a similar type elsewhere, because of the possibility of complete immobilization.

During a period when there was a pestilence of flies, an undue number of such wounds suppurated. These infections tended to remain superficial, and delayed only that part of wound healing. The percentage of empyema was also highest at this time.

In a series of 120 operations involving the chest wall, in not a single instance did gas gangrene develop, and no virulent streptococcus infection occurred.

n. Results. Statistics showing mortality rates in war injuries can never be convincing, because of the multiplicity of factors affecting the condition of the wounded. The series here analyzed is made up from some men wounded when in good condition, in warm dry weather, and given early treatment, but of more wounded of the opposite category. The work was done in field and mobile hospital units; the surgical facilities varied from wretched to excellent. Battle conditions permitting, no selection of cases was made to eliminate the bad risks. Any chance of operative benefit was given, and very gratifying recoveries resulted when fatalities were to be expected. This plan must carry with it a high mortality rate (29.6). Five deaths occurred upon the operating table, and twelve within 18 hours after operation. Thus, 63% of the total mortality (27) occurred in patients too weak to withstand the strain of operation. Among these there were very few that might have recovered if treated expectantly, but there were more that did recover, who would have died if not given surgical treatment.

The operations were performed by Lieut. J. L. Yates and Major W. F. Verdi. The same methods were employed, and virtually identical results were obtained.

The results of 91 penetrating wounds of the chest treated by thoracotomy are analyzed in Tables I and II.

No further discussion of this Table will be attempted, except to call attention to the interesting fact that though chest wounds were more commonly caused by shell fragments, the percentage of deaths was proportionate to those caused by bullets.

In Table II a grouping of this series of 91 thoracotomies is attempted on the basis of the indications of operative urgency. The subgrouping into "simple" and "complicated" has reference to the entrance of multiple factors, such as sucking wounds plus bone involvement, for example, into the decision. Overlapping,

TABLE I.—PENETRATING WOUNDS OF THE CHEST TREATED BY THORACOTOMY.

Total cases ..... 91 Total deaths 27 (29.6%)

NATURE OF MISSILE		DEATHS CAUSED	
Bullet	39 (42.8%)	11	40.8% of total deaths 28.2% of group wounded by bullets
Shell	52 (57.1%)	16	59.2% of total deaths 30.7% of group wounded by shell

		DEATHS
Group I. Chest alone involved:		
Uncomplicated	57	6 (10.5%)
Profound shock	7	5 (71.4%)
Totals	64	11 (17.1%)
		DEATHS
Group II. Chest involved, together with:		
Abdomen	9	6 (66.6%)
Other serious wounds ..	14	7 (50%)
Added profound shock (to mutiple wounds)	4	3 (75%)
Totals	27	16 (59.2%) deaths

therefore, occurs in the complicated sub-headings.

TABLE II.—A GROUPING OF THE SAME ACCORDING TO A PLAN OF OPERATIVE URGENCY.

		NO.	DEATHS	PER CENT. MORTALITY
I.	*Hemorrhage—acute anemia*	1	1	100
II.	*Sucking wounds:*			
	Simple	3	0	
	Complicated	26	10*	38.4
III.	*Bone involvement:*			
	Simple	27	6	22.2
	Complicated	42	14†	33.3
IV.	*Pneumothorax:*			
	from large bronchus injury	0	0	
V.	*Hemothorax of symptoms:*			
	Simple	4	0	
	Complicated	13	6	46.1
VI.	*Foreign body:*			
	Simple	6	0	
	Complicated	4	0	
VII.	*Hemothorax of signs:*			
	Simple	2	0	
	Complicated	1	0	
VIII.	*Through and through without signs:*			
	Simple	0	0	

* Includes one spinal wound, one abdominal wound, and one gas gangrene.

† Includes five abdominal wounds, one femur, and one section of vena agygos major.

Particular attention is drawn to the fact that no thoracotomy was performed on a simple, uncomplicated through-and-through wound of the chest. Individuals suffering from such wounds, therefore, are not included in the 91 cases. Further, it will be remarked that this series includes only those penetrating wounds of the chest treated by thoracotomy and none of the grouping of non-penetrating chest wounds operated without thoracotomy.

In conclusion we must express our grateful appreciation of help and encouragement received. To you, Sir, we are indebted for the opportunity to study this problem, for practical suggestions and sound advice. We wish to thank the officers, enlisted men connected with the Central Medical Department Laboratory, for their coöperation, particularly Col. J. F. Siler, Director of Laboratory Service, A. E. F., whose willingness and capacity to be helpful is unlimited. The American Red Cross, through the Research Department under Col. Alexander Lambert, has given essential assistance by furnishing facilities and equipment, both in the Laboratory and in field hospitals. We are greatly indebted to Major J. M. Steiner for his help and suggestion, and to Captain M. A. Blankenhorn for the benefits of his unusual experience derived from service in the B. E. F., under Col. A. B. Soltau.

Miss Anne Barnard, A. N. C., and Miss Anna Fitzgerald, A. N. C., have unfailingly shown the ability, energy, and devotion to duty typical of the highest ideals of the American trained nurse. Sgt. 1st Cl. P. W. Vestal, who has served with us from the first, and Pvt. K. Baronian, detailed more recently, have at all times been competent and willing.

Respectfully submitted:

J. L. YATES, *Lieutenant-Colonel,*
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ROBERT DRANE, *Captain,*
JAMES T. GWATHMEY, *Captain.*

SUGGESTIONS FOR IMPROVING MEDICAL EDUCATION.

BASED UPON A STUDY OF THE PRODUCT OF THE MEDICAL SCHOOLS.

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MEDICAL education has been much discussed, analyzed, adjusted in various ways and experimented with. Standardization has been attempted and certain definite requirements formulated by the Council of Education of the American Medical Association and by the State Boards of Registration, and the whole subject carefully analyzed and criticized by Flexner's report for the Carnegie Foundation.[1] All this has helped to raise the standard, to make it more effective, and to close many inferior schools. But nearly all of the study and of the criticism has dealt with the process of medical education in the school and but little attention has been paid to the analysis of the product of that education, the doctor.

It is obvious that the aim of the medical school should be to furnish to the community efficient, capable doctors; men capable of diagnosticating and effectively treating disease, of relieving suffering, of promoting the public health, of teaching medicine, and of advancing our medical knowldege, remembering always that the great majority of the profession, after their graduation, are engaged in practice, in healing the sick. The knowledge possessed by the doctor, taken in large numbers, is on the whole the best test of the efficiency of the medical schools.

This study of the product of the schools is therefore presented because a process of manufacture may be appraised in one of two ways, first, by observing the process itself, or second, by studying the product of the process. The study of the product is, of the two, the more reliable because it is based on performance and adaptation to public need. The study of the product throws light on the process as a whole and does not allow us to be misled by the fact that some parts of the process may be excellent while other parts are inferior, a matter which might be overlooked in the study of the process itself. The analysis of the product soon detects an inferior part or a disproportion or lack of correlation between them. It becomes, therefore, a study of effectiveness.

When the United States entered the war it was evident that we had only a handful of medical men competent to carry on the orthopedic work which would obviously be required in the camps, the hospitals, and the field, and in October, 1917, intensive courses for the instruction of military surgeons in orthopedic surgery were begun and were carried on until into December, 1918. The duties assigned to me by the Surgeon General from the time that I entered the army until my discharge fifteen months later, were concerned wholly with this instruction. During this period I was associated as instructor with nine intensive courses of this character, seven given at the Harvard Medical School in Boston and two at the Army Medical School in Washington.

It became evident in the first course that the instruction must be fundamental, and that in the time at our disposal we could hope only to deal with principles. The method elaborated has already been dealt with by me in a short paper entitled, "A Plea for a More Fundamental Method in Medical Examination."[2]

Although the subject taught was orthopedic surgery it is used here merely as an example to throw light on medical education in general because it became necessary to discuss more or less fundamental matters such as the anatomy and physiology of joints, their reactions to trauma, toxins, and infections, the growth and development of bones and their reactions to trauma and infections, the character of nerve impulses, and the most general principles of nerve localization in relation to paralyses and spinal fracture and injury. It also became necessary to discuss muscular functional anatomy and nerve supply in its bearing on the treatment of paralyses and the use of muscle training and transplantation. This matter is mentioned to show that criticisms of the knowledge possessed by the men was based upon a broader ground than an analysis of their knowledge of flat foot, tuberculosis of the spine, lateral curvature, etc., which might be classed as the highly specialized orthopedic subjects.

Material. The material for observation consisted of picked men from the medical corps of the army, selected and detailed to the course by the Surgeon General. There were 238 men, representing forty-three States, the District of Columbia, and Porto Rico, and coming from seventy-six medical schools. Some had just graduated, others had practised twenty years or more, nearly all had some surgical experience and some had practised orthopedic surgery.

Many were the leading men in their communities and the majority of the men were above the average.

Each course lasted from six to eight weeks and instruction continued for six hours each day, which proved to be the maximum amount of intensive teaching that the men could stand. Outside study of some hours a day was required. The contact of the instructor with these men was very intimate and in my case the instruction, which was almost wholly on patients, was carried on by the method of asking questions and drawing out the information in that way, on the ground that they were more likely to remember what they learned in this way. The didactic lecture was reduced to a minimum and an opportunity was thus incidentally afforded the instructor to learn what these men really knew, which would not have been learned from mere lectures.

Conferences were constantly held in which the students were asked to criticize the course and methods, and many of the men have been good enough to write suggestions as to improvements in the course after they had gone into active work. It is impossible to speak too highly of the interest, the enthusiasm, and the coöperation of all of these men in making the course successful. My previous experience in teaching had been largely with under-graduates whom I had instructed for many years. At the end of the time I had examined them and they passed on to other courses or to hospital work and I knew practically nothing of how effectively I had taught them. I was in the position of a surgeon operating extensively in a hospital with no follow-up system and with no way of estimating results. I had done a good deal of graduate teaching but never on any large scale and never as a "whole time" teacher. Suddenly I found myself a whole time teacher of a fairly large class of graduates in an intensive course and this course was repeated nine times in fifteen months. I was now in the position of a surgeon with a follow-up system but no hospital. In other words, I was dealing almost wholly with the results of teaching and trying to repair holes in the fabric left there in the schools by their teachers, of whom I had been one.

To repair these defects it became necessary to analyze and define them; and this was surprisingly easy when one set about it, because they practically classified themselves. These defects persisted in all the classes and characterized men from every school, from every State, and of every age and degree of experience. Appearing to be thus universal, it seems fair to attribute them to the education that they had received, or had not received, in the medical schools.

The defects classify themselves as follows:

1. Superficial and slipshod methods of examination, a tendency to make snap diagnoses and in general no approach to thoroughness.

2. An inability in most instances to think out a case on sound fundamental lines and to base treatment on meeting an established pathology.

3. A lack of an accurate or practical knowledge of anatomy, a very hazy knowledge of physiology, and often an incomplete understanding of pathology.

The men as a rule were not close observers and described unfamiliar conditions loosely and in inaccurate language. This, however, seems rather a minor defect compared to those just mentioned.

These briefly are the defects that have been most evident. There have been men of varying degrees of ability and many individual defects. The men from some schools have been a little better than the men from others, but the defects mentioned have been present in nearly every individual and the graduates from no one school can be exempted from the above criticisms.

The three main defects mentioned may be further discussed as follows:

1. Lack of thoroughness in examination and diagnosis. The almost universal disposition of the men when a case was presented to them for diagnosis was to lay great and undue stress upon the history, so often misleading; to examine only the part complained of, and to proceed to a snap diagnosis, most often without a differential diagnosis. When two different conditions existed in a patient shown them, they almost invariably missed the second. They were warned early in the course that thoroughness of examination would be required and were repeatedly told that one pathological condition did not exclude others, but so firm are the old habits that, for example, a patient with a pain in the legs and some swelling of the tibiae was examined by a student and passed by the whole class as syphilis of the tibia when, by turning him on his face and looking at his

spine, it was evident anywhere in the room that he had Pott's Disease and a well marked knuckle.

This has seemed to me perhaps the most serious defect to be met. The men under observation, however, were largely men of surgical training and what has been said would probably be less true in men trained in internal medicine. This defect would seem to reflect directly back on medical education, for a man once taught to be thorough fears to fall back into hasty methods on account of the danger and inferiority of such methods.

The suggestion made on the mind is that the men have been taught by individual teachers of different degrees of teaching ability and of different standards, but that no one has taught them thoroughness or methods of examination as a whole; that they have been supplied with blocks of knowledge of different size, shape, texture and durability but that no one has taught them how to use the blocks as a whole to advantage. It is interesting to note that these men took readily to careful methods and became more thorough in their work before the close of their course.

2. *Inability to think out cases logically and to base treatment on the pathological condition present.* When an unfamiliar condition was presented to the student in a patient, he was required to examine it thoroughly, to make a differential diagnosis, to describe what pathological condition was present, and he was then asked to prescribe a treatment based on that pathology which would meet it. If it was like any condition that he knew, he would jump to the treatment of that and try to remember what he had read about it, but if it was new territory he was apt to flounder and not use, in the solution of the question, his knowledge of anatomy, physiology, pathology, and mechanics. If a tuberculosis of the hip or a flexed knee was presented, the student sought refuge in prescribing "some sort of a brace" and no part of the course was so hard as to make them formulate for themselves the mechanical needs of a case, based on the pathology and some simple means of meeting it. This inability to apply fundamental facts of anatomy, physiology, mechanics, and pathology to familiar or unfamiliar surgical conditions suggests that there is no effective correlation between the different departments of the schools, especially between the so-called preclinical and the clinical departments, but that, in the clinical courses affections are described, demonstrated, and the treatment formulated each by itself, and the student is to put that affection in a pigeonhole in his mind and remember it as well as he can.

Particularly is it evident that they are not accustomed to think out problems in the light of their anatomical and physiological knowledge. A patient with chronic tuberculosis of the knee with subluxation of the tibia was shown. The subluxation was recognized, but in a class of thirty-five, not a man was able to account for it on anatomical and physiological grounds, although there was a diagram on the blackboard of the shape of the bones of the knee joint. By a series of questions they were made to work out the sequence that muscle spasm was present, that the hamstrings were stronger than the quadriceps, that the tibia was therefore flexed and that the shallow articular facets on the tibia permitted it to slide backward. This instance was typical of the inability to apply fundamental knowledge which was undoubtedly possessed by every man in the class.

Another typical instance of the same universal tendency was demonstrated when a patient was shown wearing two artificial legs. One of them was obviously much shorter than the other and no man in the room could suggest any means of estimating the difference except by a tape measure from the anterior superior spine, which is notoriously unsatisfactory. Finally, after prolonged questioning, a man suggested making the pelvis level by building up under the short leg and measuring the amount of the correction required, but neither he nor anyone else could describe any simple means of finding when the pelvis was level, and they had to be told to hang a plumb line in the cleft between the buttocks and correct until the spine was under it. Such instances as these, occurring practically every day and every week, month after month, impress on the instructor's mind that the medical student has not been taught to use what knowledge he has.

3. *Lack of knowledge of fundamentals. Anatomy.* As an example of the situation in anatomy, twenty students were asked at an examination, at the beginning of one course, the following questions:

1. What muscles are supplied by the ulnar nerve? 2. Describe the ilio femoral ligament of the hip, the crucial ligaments of the knee, the internal lateral ligaments of the ankle joint.

3. The structures in relation with the shoulder joint. 4. The description of five important muscles. 5. What soft parts would be injured in a gunshot wound carrying away the head of the fibula?

Although many of these men were fresh from an anatomy course in one of the camps, the results were not gratifying. The average percentage was forty-three, only five men were marked above fifty, and eleven were from twenty to forty.

One object of the course was to teach men to diagnosticate nerve injury by the loss of muscle function, and in all the sections the men were taught the function of the muscles, not only on the cadaver, but also on the living subject, by questions, and most men knew the function only of a few important muscles. To teach them this so that they knew enough of muscle function to be of any use required several days' instruction of several hours each, backed up by hours of anatomical study at home. On the whole the younger men had a better knowledge of the subject than the older men. It might be questioned by some whether it was necessary for the average doctor to know anatomy in any such detail and it might be asked how many of such could do better in the examination given; but if it is not necessary to know this why should so much time be spent on teaching anatomy, and if a man with surgical training does not know the answer to such questions as those asked, how can he be said to possess any practical or usefull knowledge of the subject?

Physiology. As an instance of this aspect of the case, twenty-five men were asked in an oral examination to state what the effect of a fracture of the spine in the upper dorsal region and in the middle lumbar region, compressing but not destroying nervous structures, would be on the patella reflex. Not one man answered correctly. Now these men had, of course, been taught the physiology of reflex action; but either they had forgotten it, or a practical application of it had not been taught them, or they had failed to use their minds in the examination. Of the passage of a motor nerve impulse from cortex to muscle, as a rule, they knew very little that was accurate and they knew very little of the physiology of muscle and the effect of stretching, chilling, or overusing it.

The remedy of the defects described would obviously be desirable and although this paper is concerned chiefly with the study of the defects, certain constructive suggestions may be offered. (1) Thoroughness and method in examination of patients should be taught by itself in a short course in any clinical department. Proper examination at present is much more insisted on in the departments of clinical medicine than elsewhere and the student should be taught that it is equally important in all branches. (2) The student should be taught to think out a case, to refer symptoms to pathological conditions, to base treatment on pathology, and to use his knowledge of anatomy and physiology in aiding in the solution of his problems. This is, perhaps, the most serious defect to remedy, for the teacher, in many instances, may not do this himself, and he cannot teach what he does not practise. Moreover, the students are too much hand fed and not trained to think and to reason out the individual case on fundamental grounds. If the student is to be taught to think, the teaching must be made more educational in the real sense, for education by its derivation means drawing out and not forcing in. In addition, the fact that memory is greatly strengthened by association does not seem to have been utilized in the medical curriculum to its proper value; and the student has been too much expected to memorize isolated rather than associated data. (3) Anatomy and to a certain extent physiology are either (a) incompletely taught or taught in such a way that the student does not remember his facts, or (b) discontinued too early in the course, or (c) forgotten, as we forget our Greek or Latin. It has been commented on abroad of late that the American surgeon compares unfavorably in anatomical knowledge with his British colleagues and certainly the American doctor as I have seen him in the last year does not know his anatomy as he should. In the matter of physiology there is little tendency to regard it as anything but an abstract branch and the application of physiological principles to everyday surgery is almost wholly an unknown art. This suggests a self-evident criticism of the teaching of physiology. Anatomy and physiology should be taught not as abstract sciences alone but their practical application given in the pre-clinical period and later emphasized and amplified in the period of clinical courses. This division seems necessary because the stu-

dent in the pre-clinical period is not sufficiently advanced to appreciate many of the more important applications, which to be made effective must be taught after some clinical instruction. This implies a definite and active correlation between preclinical and clinical departments. (4) To bring into touch the different subjects, a better system of correlation must be devised and followed. Most medical schools consist of an aggregation of separate departments, each teaching its own subject in its own way and at its own time. Gaps are left in some places and repetition occurs in others. No proper correlation can be accomplished without actual central supervision on the part of the Dean or of a committee working under him. There is too much "state rights" and too little "Federal control." (5) There is in most schools a lack of central businesslike control of the clinical teaching, each department being left to conduct its own affairs. Without a knowledge of what is being taught in other departments, no effective correlation is possible. This difficulty can be largely remedied by having handed in to the Dean at the end of each month a short written synopsis of every clinical exercise given in the school during the period. The students are willing to do this and it is easy to secure volunteers from every class or section. These synopses should be mimeographed and sent monthly to the head of every department in the school. This is not only necessary for proper correlation but is a check on the efficiency and faithfulness of the junior teachers.

These criticisms are offered in all modesty by a teacher of orthopedic surgery, but the ground covered was general and the criticisms deal with general methods and standards. We must bear in mind that the object of the medical school is to make good and efficient doctors; and no matter how good or elaborate the medical curriculum may be, if it fails in furnishing such good and efficient doctors it needs revision and improvement.

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PNEUMONIA AND EMPYEMA.

BY FIRST LIEUT. HORACE GRAY, MEDICAL CORPS, U. S. ARMY.

[From Medical Service, Base Hospital, Camp Devens, Mass.]

(*Continued from page 391.*)

29. Purulent Peritonitis. There was only one case, 11,448, and he had pus in no other serous cavity. He had a type I lobar pneumonia of the R U L and R L L, had jaundice, developed right pleurisy only on the *thirteenth* day of the disease, and died on the eighteenth day. Obduction showed consolidation not only of the R U L and R L L, but also of the L U L, with no fluid in the right pleura, 1100 *cc.* not purulent in the left, 70 cc. not purulent in the pericardium, but 300 cc. thin greenish pus in the peritoneal cavity.

30. Diagnosis of Effusion has been difficult and many explanatory taps have been made in vain.

a. We have felt, like Cole, "that it is probably of great importance to detect . . . . small amounts . . . . and . . . . as early . . . . as possible." The chest has therefore often been needled on only slightly suspicious signs in the patient's condition, even without definite physical or x-ray signs of fluid.

b. We have too often been content to use one of the smaller three (of the four) needles supplied with the Potain aspirator. Nothing smaller than a 14 G, B & S, should be used. Even that has several times let out surprisingly small amounts; and in these cases the medical side has felt the inadequacy of aspiration as a method of drainage.

c. So many cases show no effusion that at times the search lags. Floyd has commented ("Pleurisy," *Journal Medical Research*, 1914-15, XXVI, 261) on the infrequency of effusion in comparison with the frequency of pleural inflammation: "Following lobar pneumonia the pleura is practically always involved . . . . yet in Musser's series of 127 autopsies in pneuminoa, only 4% showed serous effusion, and 16% purulent." Of our 241 cases, 2% had serous effusion and 22% pus.

31. The Character of the Fluid here, as in other army camps the past winter, has been remarkable for its thin turbidity rather than the more familiar pus of civil life. The surgeons still prefer to delay operation till the effusion becomes large, purulent, or marked by free bacteriologic growth. The medical service, on the

other hand, is inclined to feel that thin exudate is often graver than thick, just as with middle ears, and that, therefore, with any growth, the effusion though small and merely turbid, is a potential empyema and should be drained by incision.

Where there has been a positive culture (or in one case, where the fluid was markedly purulent and the patient prostrated like the typical civil empyema), the case has been considered an "empyema." Serofibrinous fluid with negative culture has not been considered an empyema. This obviously arbitrary classification is easy to attack, but the answer is made that any classification will be open to objection until closer study of fluids (by the cell counts, differentials, cultures, and outcome), shall have indicated how far the criterion of a suppurative pleurisy should be *growth* or how far it should be *pus* (though sterile). Our feeling is that "empyema" should continue to be used to indicate the "severe symptom" (Cole), *the* complication to be watched for; and that, therefore, its presence should be diagnosed, not on the basis of sterile pus (which can hardly be thought grave), but on the basis of a positive culture (which, as our figures show, must be always considered with anxiety).

32. Serofibrinous Pleurisy with a negative culture was present in only 17 cases, *i.e.*, 6%, of the 485 pneumonias. These were referred to the Tuberculosis Specialist, but none was diagnosed by him as tuberculosis. These cases were included in the series of empyemas. Total fluid removed from each patient was 3400, 2950, 1050, 900, 850, 650, 600, 240, 226, 100, 70, 60, 30, 6, 5, 3, and 1 cc., respectively.

33. Empyemas with Negative Culture on First Tap.

a. Nine of the seventy-seven empyemas gave sterile fluids on the *first* exploratory and showed a positive culture only later, *i.e.*, in 12%.

b. Yet the volume in these nine taps was as high as 600 cc., and averaged 277 cc.

c. The positive culture was obtained from the second to the sixteenth day after the sterile tap; average, 10 days.

d. The volume of the fluid with growth was in a third of the cases 5 cc. or less, and averaged 442 cc.

34. Rapid Onset of Empyema was noted most strikingly in Reg. No. 4794, who died on the third day of his pneumonia and on the table was found to have an undiagnosed left pyothorax of 2700 cc. The following had positive cultures on either the third or fourth day of their pneumonias:

12,058	1050 c.c.	PK + ST
7,897	800 c.c.	ST
7,952	700 c.c.	PK + ST
9,142	500 c.c.	ST
11,392	400 c.c.	ST
12,286	200 c.c.	ST
5,193	80 c.c.	ST
9,317	60 c.c.	PK
11,600	20 c.c.	ST
3,623	1 c.c.	ST

The following had positive cultures on either the second or first day of their pneumonias:

4,406	700 c.c.	ST
7,265	500 c.c.	ST
7,364	5 c.c.	ST

These cases confirm the experience known to others, but unknown to too many, that effusion must be anticipated even *before* the crisis. We have had, however, no record of any such rapidity, "within a few hours," as that "repeatedly remarked" by E. E. Irons and D. Marine, (*Jour. A.M.A.*, March 9, 1918, *70*, p. 688). Nor did we have any such fulminating cases as those of Hamburger's ("Pneumonia and Empyema at Camp Zachary Taylor, Ky.," *Jour. A.M.A.*, March 30, 1918, *70*, 915): "Many came into the receiving ward from the regiments with chests full of pus."

35. Empyema Opposite Pneumonia. Only one patient (Reg. No. 8546) developed empyema on the side opposite the pneumonic consolidation. The fluid obtained (10 cc.) showed pneumococcus culture. No. op. done. Patient alive and improving.

36. Primary Empyema, i.e., Pneumococcus Infection without Pneumonic Consolidation. It will be noted that two cases of empyema without preceding consolidation have been included in this series of 485 pneumonias. This is done because of the view that the consolidation is a habitual episode in pneumococcus-septicemia rather than a local disease. In empyema we feel just as "in abortive pneumonia . . . . we know, that a pneumococcemia may exist without (pulmonary) symptoms and also that the symptoms of pneumonia depend more on toxemia than upon the extent of pulmonary involvement." (Norris, p. 237.) Cole (*l.c.* 1149) cites a rather similar "apparent pulmonary infection with type IV . . . . during convalescence from measles. There was a pleural exudation . . . . but the signs of lobar pneumonia were never

definite." . . . . Of these cases Hamburger says: "Many cases diagnosed clinically lobar pneumonia showed at necropsy no evidence of pneumonic consolidation, but contained large amounts (3 *liters* and more) of empyema pus and atelectatic lung tissue. Such cases may be considered *primary suppurative pleuritis.*" He also quotes Jochmann as earlier authority for this view. That some empyemas are "primary pleural infections" is also agreed by Babcock and by Lord. Similar, too, is Mallie's report (Mallie, H., "Pneumococcus Meningitis," *Journal de Médecine de Bordeaux,* March, 1918, *89,* No. 3) of pneumococcus meningitis without lung consolidation, confirmed by necropsy. He cites still another case reported by Weill in 1915. Incidentally, this finding was so rare (1 in his 244 pneumonias), that like ours it might be thought by the more sceptical to be due simply to oversight of the lung involvement. However, our view has material support in the recent discovery by Colonel Gordon, (Gordon, M. H., *Jour. R.A.M.C.,* Jan. 1918, xxx 1-22) that meningococci can be divided into four types like pneumococci; and also the recent observations by Major Herrick, (Herrick, W. W., *Arch. Int. Med.,* April, 1918, xxi, 541) that meningitis, while a habitual episode in meningococcus septicemia, was however, absent in 4% of his cases.

The sceptic will say that these instances of pneumococcus infection were localized primarily in the pleura only apparently, while in reality the preceding consolidation was missed. An answer to this is presented by the following remarkable cases in which effusion occurred a week before consolidation: Reg. No. 13535, Pvt. in Infantry, age 28, W, service: 6 months, born in Mass., was, on May 4, admitted to a surgical ward for an abscess of the neck, posterior, deep, acute, suppurative. T. 104—P. 120—R. not taken. It was incised and drained the same day. No ether. On May 8: "Drainage good but temperature continues high. Compl. pain, right lower chest." (Capt. M. A. Watkins, M.R.C.). The medical consultant (Major D. M. Hoyt, M.R.C.) diagnosed "Fluid, right base." X-Ray (Major E. L. Davis, M.R.C.) showed "coarse mottling, 4th rib to diaphragm. Diaphragm very high. Interpretation: Acute congestion, lower right chest."

On May 11 a second ray showed: "Shadow over entire rt. side, from first rib downward. Typical S-shaped shadow of pleurisy with effusion. Heart pushed to left. Coarse mottling first i.s. on rt. No evidence of pneumonia. Interpretation: Pleurisy with effusion." On May 12th the internist (Major F. S. Churchill, M.R.C.) noted: "In lower half of rt. back, dullness merging into flatness at extreme base, with diminished T.F., voice sounds and resp. murmur." On May 13, the third radiograph still showed no evidence of pneumonia. "Shadow from third rib to diaphragm. Interpretation: Pleurisy with effusion, rt." On May 14, the first tap gave 800 c.c. fluid, but the smear and culture were negative. Later in the day the clinician (Major Hoyt) diagnosed: "Pneumonia R.L.L. and some fluid." On May 18, the second tap yielded 250 cc. turbid fluid, smear and culture neg. On May 20: "Consolidation of R. L. L.; considerable temp.: 102.2—100—22, but not very sick." (Capt. J. W. Moore, M.R.C.) On this day, for the first time, the X-Ray showed consolidation: "Haziness from clavicle to third rib. Dense shadow from second rib at periphery, extending to third rib midline to diaphragm rt. From fourth to diaphragm shadow much denser, rt. Heart pushed to left, but not especially enlarged. Interpretation: Pleurisy with effusion, rt. lobar pneu. rt. lower lobe." On May 23, about the same temp, 103—104—28, and same physical signs. On June 5th, temp. was normal, 98.6—100—24, but the signs were persisting.

(To be continued.)

Book Review.

The Canadian Medical Weekly. Hamilton, May 27-June 1, 1918. Published under the auspices of THE ONTARIO MEDICAL ASSOCIATION. Toronto: The Macmillan Company of Canada, 1918.

This volume is a collection of papers and discussions submitted at the recent medical congress in Hamilton, Canada. Nine sections are represented as follows: Eye, ear, nose and throat; medicine: obstetrics and gynaecology; pediatrics; public health; the returned soldier problem; surgery; tuberculosis, and the museum laboratory. The papers are dedicated to the great war and deal with the alleviation of suffering with this purpose in mind. The authors are representatives from the large clinics of both Canada and the United States.

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SMALLPOX VACCINATION.

IN a previous issue of the JOURNAL, there has been published material relative to the annual anti-vaccination agitation. In this connection, a circular letter and pamphlet recently issued by the Health Department of Boston is of interest to the profession. The letter states that four cases of smallpox have lately been discovered in Boston, the patients all members of a crew of a fishing boat. As a considerable number of exposures occurred before the presence of the disease in Boston was known, it is the hope of the Health Department that the community will avoid the spread of the disease by general vaccination. The purpose of this letter is to warn the profession of the presence of smallpox and to solicit coöperation in the promotion of vaccination throughout the community.

The pamphlet accompanying the letter is an interesting exposition of vaccination in its relation to smallpox, by Dr. Jay F. Schamberg, and is one of a series prepared by the Council on Health and Public Instruction of the American Medical Association. It describes the prevalence and virulence of smallpox in England before the introduction of vaccination, in 1798, by Dr. Edward Jenner. In London, during the eighteenth century, smallpox caused one-twelfth of all deaths, and it was felt that everyone would have to pass through an attack at some period of his life. In this pamphlet, the sources of smallpox infection, its symptoms, and various stages of the disease are described; it has been circulated among members of the profession in order to arouse them to the danger from smallpox, which has been discovered in the community.

INFLUENZA AND VENTILATION.

A RECENT issue of *The British Medical Journal* mentions the importance of air conditions in matters of health, and suggests deep breathing, exercise, and sleeping in the open air as important measures in combating the infection of influenza. The following comments are applicable to the American as well as to the British public:

"Although man has lived in houses of one kind or another for several thousand years, and in western Europe since the introduction, somewhere in the fifteenth century, of glass for domestic windows, in houses which can be almost hermetically sealed, yet a human strain capable of withstanding the evil influences of unventilated rooms has not so far been evolved. Our ancestors of a few centuries ago immured themselves in tightly-closed houses, slept in bedrooms with windows closed, sometimes even in cupboards or box beds with shut doors. The result was reflected in their mortality, in the prevalence of the plague and other diseases, and in their short average span of life. Though we are wiser than they, and pay lip service to the virtues of fresh air, and talk much and learnedly on ventilation, the severity of the present pandemic of influenza is enough to show that we need to grow wiser."

ST. BARTHOLOMEW'S HOSPITAL.

THE history of St. Bartholomew's Hospital is interesting to the profession because of its reflection of early medical progress in England. The hospital was founded in 1123, when

materials were scarce and the universities had not yet been established. The *History of St. Bartholomew's Hospital*,* by Dr. Norman Moore, describes the medical knowledge of those times. During the early history of St. Bartholomew's, the only medical book available was the fourth book of the *Liber Etymologiarum* of St. Isidore of Seville. As this covers only a narrow range of subjects, it is probable that physicians of that day acquired the greater part of their medical knowledge from bedside observation. Within two centuries, however, more medical literature was available; for John Mirfield, probably the first physician of St. Bartholomew's Hospital, and the author of his *Breviarium Bartholomei*, was familiar with Gordon's *Lily of Medicine*, Gaddesden's *Rosa Anglica*, and the *Compendium* of Gilbertus Anglicus. For four hundred years the hospital maintained its character as a religious house, with an annex devoted to the exhibition of charity for the poor; not until 1535 did the hospital become prominent as a place for the treatment of people who were suffering from illness.

* Reviewed in a recent issue of the *British Medical Journal*.

CANDIDACY OF DR. BRADFORD FOR OVERSEER.

ALL physicians who are also Harvard graduates should be actively interested in the candidacy of Dr. Edward Hickling Bradford for Overseer of Harvard College. Upon the expiration this year of Dr. George B. Shattuck's term of office, the Board of Overseers will be left without a representative of our profession, unless another of its members is elected. Dr. Bradford is peculiarly well qualified in both personality and experience to promote the welfare of the Medical and Dental Schools in this position, and it is particularly desirable in their interests as well as from individual loyalty that graduates of those schools who are qualified to vote should ensure Dr. Bradford's nomination and election.

MEDICAL NOTES.

TRIBUNAL FOR MEDICO-LEGAL QUESTIONS.—Dr. Avendaño, professor of forensic medicine at the University of Lima, is reported to have expressed the belief that a tribunal for the adjudication of medico-legal questions was established in 1570 by a decree of Philip II, and continued in exercise until 1851. Burial and embalming were its primary interest in the sixteenth century; in the seventeenth, cases of sudden death were investigated; and Caesarean section post mortem was carried out in the eighteenth. A special institute was founded with a toxicological laboratory and a post-mortem room in the nineteenth century. The Government, the police, and the medical faculty constituted the combined authority of the institution. Dr. Avendaño advocates the establishment of a medical and juridical institute, which should be equipped with a staff of chemists, psychiatrists, and jurists supplied by the faculty of law.

INFLUENZA IN THE BRAZILLIAN ARMY.—A recent report from Rio Janeiro states that influenza exists in epidemic form in the Brazilian army, and that there are three hundred cases in the Rio Janeiro military hospital alone.

APPOINTMENT OF DIRECTOR OF CLINICS, MASS. STATE DEPT. OF HEALTH.—Dr. Hugh Cabot of Boston has been appointed Director of Clinics in the Subdivision of Venereal Diseases of the Massachusetts State Department of Health.

His efforts will be toward the standardization of work in the sixteen state approved venereal clinics and toward familiarizing the physicians of the State with the opportunities for expert treatment and advice to be found in them.

COURSE IN PUBLIC HEALTH ADMINISTRATION.—A practical training course in public health administration will be conducted in New York City during the coming spring by the New York Academy of Medicine and the New York Bureau of Municipal Research. The contemplated course is planned to cover a period of six weeks, beginning April 30, 1919. During the first three weeks of the course, public health experts of national reputation will conduct lectures and conferences; the last three weeks will be devoted to field study and observation of health work and institutions in and about New York City. Persons who enroll for the course must give assurance of attendance for at least the first three weeks.

The purpose of this training course is to

make it possible for health executives, by coming in contact with the leaders of public health thought and action in the United States, to acquire new ideas for use in their own work. The administrative rather than the technical medical side of public health work will be emphasized. The course is outlined in the Public Health Report for March 7, 1919.

MEDICAL STRIKE IN GERMANY.—It has been reported recently that in Leipzig and in other towns in Germany there has been a "strike" among the doctors, chemists, teachers, and journalists as a protest against the workmen's strikes. It is reported also that there is a severe epidemic of smallpox in Germany at the present time, which, in view of the fact that medical attendance is unobtainable, is presenting serious difficulties.

BRITISH MEDICAL SERVICE IN THE WAR.—*The British Medical Journal* has published recently figures which show the increase in the British R.A.M.C. between 1914 and 1918.

August, 1914.
Regular: Officers, 1,279; Other ranks, 3,811.
T. F. and T.: Officers, 1,889; Other ranks, 12,520.
Totals: Officers, 3,168; Other ranks, 16,331.

October, 1918.
Regular: Officers, 10,289; Other ranks, 102,312.
T. F. and T.: Officers, 2,863; Other ranks, 30,605.
Totals: Officers, 13,152; Other ranks, 132,917.

The officers enumerated in 1918 included 820 dental surgeons.

BOSTON AND MASSACHUSETTS.

WEEK'S DEATH RATE IN BOSTON.—During the week ending March 22, 1919, the number of deaths reported was 228 against 280 last year, with a rate of 14.93 against 18.61 last year. There were 36 deaths under one year of age against 36 last year.

The number of cases of principal reportable diseases were: Diphtheria, 49; scarlet fever, 63; measles, 12; whooping cough, 11; tuberculosis, 67.

Included in the above were the following cases of non-residents: Diphtheria, 5; scarlet fever, 7; tuberculosis, 11.

Total deaths from these diseases were: Diphtheria, 5; scarlet fever, 1; whooping cough, 1; tuberculosis, 23.

Included in the above were the following non-residents: Diphtheria, 1; tuberculosis, 2.

RETURN OF MEMBERS OF HOSPITAL UNITS.—The enlisted personnel of the Massachusetts General and the Boston City Hospital Units returned to New York on March 24. The former served at Base Hospital No. 6, near Bordeaux; the latter at Base Hospital 7 at Jou-les-Tours. Lieutenant-Colonel John J. Dowling of the Boston City Hospital Unit did not return with the Unit; he and 15 other officers left St. Nazaire, France, on the *Tivives*, which will return by a circuitous route and did not arrive until March 29. The City Hospital Unit came home in command of Lieutenant Harry S. Peacock of Boston, the dental surgeon of the Unit. The Massachusetts General Hospital Unit returned under command of Lieutenant-Colonel Lincoln Davis of Boston. Colonel Frederic A. Washburn, who went over with the Unit early in the war, was on duty in England, where he had been for some time directing the work of several American hospitals.

Among the officers of the Massachusetts General Hospital Unit No. 6 who returned on the *Antigone* were: Lieutenant-Colonel Lincoln Davis, Captain George A. Leland, Lieutenant Douglass Bassett, Lieutenant Charles S. Glasgow, and Lieutenant Edward O. Roundy.

Among those of the Boston City Hospital Unit to return were: Lieutenant Harold L. Peacock, Lieutenant James J. Putnam, Lieutenant Fletcher H. Colby, Lieutenant Richard L. Ahearn, and Lieutenant Richard D. Peters.

LECTURES ON PREVENTIVE MEDICINE AND HYGIENE.—The Cutter Lectures on Preventive Medicine and Hygiene, by Harry E. Mock, M.D., Lieutenant-Colonel, M.C., U.S.A., Division of Reconstruction of Disabled Soldiers, on "Industrial Medicine Considered from an Economic Standpoint" and "Reclaiming the Disabled," were held on March 17, 1919, at the Harvard Medical School.

These lectures are given annually under the terms of a bequest from John Clarence Cutter, whose will provided that the lectures so given should be styled the Cutter Lectures on Preventive Medicine, and that they should be delivered in Boston, and be free to the medical profession and the press.

HEALTH EDUCATION IN FRAMINGHAM.—The Community Health and Tuberculosis Demonstration of Framingham has conducted educational work with two primary aims: (1) for

the instruction of the people of Framingham regarding the methods and objects of the Health Demonstration; (2) to educate all groups regarding hygienic practices and practical measures of disease prevention. Measures have been taken for the prevention of infection, for increasing personal hygienic measures, for the suppression of disease, and for the promotion of increased resistance to disease. In carrying out this program, leaflets, placards, displays, health exhibits, and literature for distribution in schools, factories, and baby clinics have been utilized. Local newspapers have coöperated by contributing space for the publication of health letters. A recent issue of the Bulletin of the National Tuberculosis Association contains a list of 62 subjects which have been discussed for the benefit of the community.

WESSON MATERNITY HOSPITAL.—The Wesson Maternity Hospital in Springfield, Mass., has not appeared in the columns of the JOURNAL since the notice of the dedication in December, 1908. No printed notes have been made except the notices of the annual meetings of the corporation and of the trustees in the local papers. The progress and success of this hospital is interesting because as a public institution it is unusual. Mr. D. B. Wesson built and equipped the hospital and provided an endowment of $200,000 by his will. The hospital has never had any other money contribution and is maintained entirely by the payments by patients and the endowment income.

Under the trustees the management is by a finance committee (*n.b., not doctors*) and by a board of managers of three physicians from each of the two schools of medicine. This board is the same as at the beginning except for two deaths. There is no medical staff of any sort, each patient employs her physician as in her home. The hospital furnishes accommodations according to the requirements of the patient. Most of the rooms have baths and some of them balconies. The nursing service is the same for all except when patients bring in an individual nurse from outside. The wards are of eight, four, and two beds. The charge per week is from $17 to $45. Any physician can have a case admitted free by vouching for her as deserving, and agreeing to attend her gratuitously.

An adequate number of skilled head nurses is maintained for day and night service. The pupil nurses come from other hospitals and are required to have had 18 months training. They come for four months in maternity work and class instruction, and passing a written examination receive the diploma, and the time is allowed by their hospitals.

At present there are 17 from the Massachusetts General, 9 from the Springfield, and 4 from the Memorial hospitals. Diplomas have been given to 700.

The superintendent, who was already well known in hospital management when she assumed the details of the hospital organization and of the training school, is still in charge. The patronage is from all classes in the community, and a large anxiety of the management is to provide for all who apply. Every available space in the hospital building has been converted for patients' use, even to screened beds in the corridors, and still cases are refused because there is no place to put them. The uncertainty of dates is a very troublesome problem. Two dwelling houses opposite the hospital grounds have been purchased in order to provide rooms for additional nurses and for domestic servants.

During the first few years the number of patients was within the capacity, but there has been a rapid increase in the succeeding years —1918 being the record, with 1,047 cases, more than one-fourth of the number recorded in the city for the year. The Wesson Maternity has been popular with the physicians from the start, and that it is appreciated by the public is shown by the hundreds of patients who return for subsequent confinements. The records show a large re-entry list for the second and third, and many for the fourth and fifth, and several for the sixth time. Lately the record reached case No. 7,000 which, with almost an equal number of babies, indicates the amount of the work.

The value of hospital care in maternity is well recognized in Springfield and the general hospitals all provide for such cases, the Catholic Mercy Hospital having a special building and a large patronage.

NEW ENGLAND NOTES.

Connecticut Hospital for the Insane.—The report of the Connecticut Hospital for the Insane for the past two years offers a complete summary of the purposes of the institution and the work which has been accomplished. The hospital has been obliged to face the trials which have been common to the whole country; unprecedented rise in the cost of necessary supplies has presented economic problems, and the shortage of physicians has made it difficult to maintain adequate ward service. From October 1, 1916, to September 30, 1918, there has been a daily average of 2,615.8 patients in the institution; 1,216 of these men and women have been regularly employed at some form of occupational training. No out-door work is assigned to patients except under medical direction; the form and duration of occupation, together with the patient's reaction to it, are regarded as distinctly medical matters. In re-educational classes, kindergarten methods, primary school work, simple art work, and calisthenics have stimulated the interest of patients and awakened initiative. A sewing class for about 20 patients has been formed and some productive work has been accomplished. For the more demented patients among the women, a class has been formed where work is done in picking apart curled hair for mattresses, and in tearing and sewing rags for rugs. Male patients are occupied chiefly by cement work and the manufacture of brushes and brooms. There are eight special occupational classes with nine teachers and an average of two hundred patients receiving training. Recreation is provided for the patients in the form of weekly dances and moving pictures.

The group of dementia praecox constituted the largest number of first admissions, senile psychoses the second, alcoholic psychoses the third, and manic-depressive psychoses the fourth largest groups. The work of the laboratory, which has been developed to a high standard of practical and research efficiency, deserves especial emphasis. In addition to the general hygiene measures, such as the analysis of water and milk, the laboratory has made and assisted in the administration of typhoid and paratyphoid A. and B. vaccine for about 3,100 patients, and has made 1,027 tests of blood serum. During the biennium, 177 autopsies were performed, and microscopic preparations of the brain and internal organs of each case have been made. Research work has been carried on with acetic anhydrid sulphuric acid. The number and condition of patients, and causes of deaths are recorded in statistical tables in the report.

Maine Commission for the Feeble-Minded.—The problems involved in the care, treatment, and ultimate elimination of the feeble-minded are becoming more fully appreciated and investigated. In 1917, the Legislature of Maine appointed a commission to make a thorough study of the conditions within that State. The report of the Maine Commission for the Feeble-minded, assisted by the National Committee for Mental Hygiene, has been published recently.

The survey was limited to an investigation of the mentally deficient. One hundred and sixty-two cases were intensively studied and case records made. Returns were obtained from 164 cities, townships and plantations, and 121 institutions, including almshouses and jails. Estimates of the numbers of the feeble-minded in these institutions were secured from local observers of unusual intelligence, experience, and opportunity for observation. Twelve rooms of public school children and four special groups were given congregate intelligence tests, and three degenerate communities were several times visited in the process of collecting data. The intelligence tests used in the schoolrooms were those of Captain Lyman F. Wells, psychologist of McLean Hospital, Waverley, Massachusetts. The tests used in individual personality examinations were: (1) psychiatrical tests adapted to the determination of the absence or presence and the varieties of mental diseases, (2) searches in the field of intelligence by means of the standard "Terman Tests," enabling a numerical evaluation in terms of intelligence quotient and intelligence age level, supplemented or substituted in the case of adults by unstandardized tests which have been found of value in classifying mentalities of adults, and (3) searches in the field of character by the inductive method; since tests in this field, like those in the field of mental diseases, are not yet susceptible of numerical scoring.

The Commission found that the low-grade feeble-minded group was lacking in all the higher, later developed attributes, such as filial

regard, patriotism, altruism, courage, judgment, initiative, foresight, and responsibility. Members of the high-grade feeble-minded group are not obviously feeble-minded. With this class it is more difficult to deal, inasmuch as their better mental equipment enables their greater activity and at the same time enables them to conceal with partial success their mode of life when it is discreditable. Members of both these groups present a great variety and diversity of mental peculiarity and equipment. The cost to the State in 1917 was $87,683, much of which was probably due to the uncontrolled activities of the high-grade feeble-minded.

There were found in Maine 1,659, or 2.12 per thousand of population, feeble-minded; it is probable that the higher grade cases of mental defect constitute on the whole a far greater sociologic and economic menace. The number of Maine men rejected for military service because of mental deficiency was 667, and six states have less creditable records than Maine in this respect.

The report of the Commission contains tabulated records of intelligence age level, the age and distribution of the feeble-minded in the State, their earning capacity, and marital condition. Case histories of feeble-minded individuals and families are cited. The recommendations of the Commission emphasize the necessity of formulating definite plans for diminishing feeble-mindedness. Among the more immediate needs are mentioned: education of the public on the problems of feeble-mindedness, the extension of mental clinics, provision for the enactment of a suitable commitment law, increase in the capacity of State institutions for the care of feeble-minded, more intensive teaching of psychiatry in the State medical schools, and the extension of medical inspection in public schools. The report of the Maine Commission for the Feeble-minded reveals conditions which show the importance and necessity of thoroughly investigating and attempting to solve the problems involved in the care of the feeble-minded.

BUTLER HOSPITAL.—The seventy-fifth annual report of the Butler Hospital, Providence, R. I., records the activities of this institution during the year 1918. At the beginning of the year, there were one hundred and forty-three patients in the hospital; there have been admitted twenty-nine new cases, and one hundred and twelve have been discharged. The State has coöperated with the hospital by giving aid to seventy-four persons. Butler Hospital granted one hundred and twelve beneficiaries during the year for the relief of sickness and sorrow.

Butler Hospital is primarily intended for the acute and curable forms of nervous and mental disease, although it has been neither possible nor practicable to exclude all chronic psychoses. Eighteen per cent. of the admissions have been dementia praecox patients. The number of admissions has necessarily been below normal, because of a lack of men in the hospital service.

Fourteen nurses were graduated from the training school in 1918. Thirty-one new men were employed during the year in the male nursing service, although most of them remained only for short periods. The hospital did not escape the epidemic of influenza, though the disease was limited almost entirely to employees and nurses. The service rendered to the hospital and its patients by the members of the staff has been loyal and untiring, in spite of the difficult conditions with which the various departments were at times confronted.

Obituary.

ELTON JAMES BASSETT, M.D.

ELTON JAMES BASSETT, M.D., a retired Fellow of The Massachusetts Medical Society, died at his home in Taunton, March 16, 1919, at the age of 74. The son of James Taylor Bassett and Caroline E. Jones, he was born in Taunton February 5, 1845. He was educated at the Taunton High School and at the Lawrence Scientific School at Cambridge. His medical degree was taken at Harvard in 1869, when he joined The Massachusetts Medical Society and settled in practice in his native city. There he attended to a large practice until two years ago, when failing health caused his retirement. He was a member of the Charles H. Titus Lodge A. F. and A. M. His widow survives him.

Miscellany.

THE ADMINISTRATION OF THE INSTITUTIONS FOR THE CARE OF THE INSANE, EPILEPTIC, AND FEEBLE-MINDED IN MASSACHUSETTS. PROPOSED LEGISLATION A BACKWARD STEP.

On February 20th, 1919, the Supervisor of Administration submitted to the Legislature a plan for the establishment of a Department of Public Institutions. This measure abolishes the Commission on Mental Diseases, the Bureau of Prisons, the Board of Parole, and the authority of the State Board of Charity so far as it relates to institutions. It also abolishes the existing Boards of Trustees as such, and provides for their continuation as a Board of Visitors only. The government of the department is to be vested in a Board of Control of nine members, one of whom is to be a director and chairman. The director is to act as the executive officer only; while the Board is to make appointments, fix salaries, make rules and regulations, and determine matters of general policy. It would have authority to appoint and remove all its officers and employees and the principle officers of the institutions. This arrangement would render the Director practically powerless.

The administration of the institution for the insane, epileptic, and the feeble-minded, would mean the inauguration of a system in Massachusetts which has not proved to be satisfactory in any other State with a similar number of institutions. There are now Boards of Control in eleven States, as follows: Arkansas, Iowa, Kentucky, Minnesota, North Dakota, Oregon, Tennessee, Vermont, Washington, West Virginia, and Wisconsin. Col. Thomas W. Salmon, Medical Director of the National Committee for Mental Hygiene, New York City, after a careful study of the administration of the institutions in this country under boards of control, made a report on this subject, which reads, in part, as follows: "Under boards of control, politics influence the care of the sick to a degree unknown under different types of supervision, and the scientific and humane aspects of the work undertaken are generally subordinated to doubtful administrative advantages. With hardly an exception, these boards of control have not endeavored to secure better commitment laws, to lead public sentiment so that higher standards of treatment will be demanded, or to deal with the great problems of mental disease in any except their narrowest institutional aspects. * * * * It is an essential part of the policy which places the care of the insane under this form of administration, that there shall be 'no division of responsibility;' and, seemingly, there is no place in such a scheme for bodies which are as much interested in the personal welfare of these wards of the State as they are in governmental 'efficiency,' and which, moreover, are directly accountable to their neighbors—the friends and relatives of the patients." . . . . "It is interesting to compare some of the conditions mentioned with those existing in states in which the care of the insane is intrusted to boards created for that special purpose. In these states—California, Maryland, Massachusetts, and New York,—it can be said truly that the care of the insane reaches its highest level."

The administration of all state institutions by a Board of Control may be necessary and advisable in states where the total institution population amounts to only one-half or one-third of that of the hospitals for the insane in Massachusetts. Boards of Control were originally established in states where the number of institutions did not warrant a separate department for the insane. To establish an administration of this kind in Massachusetts is to revert to the method of control existing in 1879, when the Board of Health, Lunacy, and Charity was created. It was soon found that this was too large a proposition for one board, and a separate Board of Health was established in 1888. It was only a short time until it was found that the insane and charitable institutions constituted too large a field for one board, and a separate State Board of Insanity was established in 1898.

To combine the charitable institutions, the hospitals for the insane, the feeble-minded, and the epileptic, and the prisons, in one group at this time, means a backward step of forty years: This should not be possible in Massachusetts. It would mean an inevitable lowering of standards in the care of the mentally diseased. Massachusetts has been held a model, as having one of the best systems of caring for the insane in the United States. To submerge the Hospital Department in an institution group which is to

include the Charitable and Penal Institutions, is to reduce the high standards established in the hospitals for mental diseases to the level of custodial institutions caring for paupers and convicts.

ALBERT EVANS,
Secretary Massachusetts Hospital Trustees Association.

Correspondence.

LETHARGIC ENCEPHALITIS.

State Department of Health, Boston.
March 17, 1919.

Mr. Editor:

Articles have appeared in the United States Public Health Service Weekly Report of February 21st, and in medical journals as well as newspapers dealing with "Lethargic Encephalitis" or a condition popularly known as "sleeping sickness."

With all conditions obscure in etiology and diagnosis there will be many cases reported which will simulate a much advertised or "popularized" disease but which, upon closer study, will prove to be an atypical form of some well recognized disease.

The Massachusetts Department of Health is anxious to make an epidemiological study of all illnesses simulating "Lethargic Encephalitis" and would appreciate it if physicians who have such cases, and who are willing to have them investigated, would notify the Department, Room 546 State House.

Thanking you for assisting us in calling this condition to the attention of the physicians of Massachusetts, I am

By direction of the Commissioner of Health,

Very truly yours,

B. W. CAREY, *Epidemiologist.*

EARLY HISTORY OF HARVARD MEDICAL SCHOOL.

Boston, March 19, 1919.

Mr. Editor:

I am interested in the history of the Medical School of Harvard College during the years 1810 to 1815, when the school occupied rooms over the Drug Store of Mr. William B. White at 49 Marlborough Street. At that time Marlborough street corresponded to what is now Washington street between Summer and School streets, and number 49 now corresponds to 396 Washington street, next to the store of McCullar, Williams, and Parker. The Boston Medical Library, and the Massachusetts Medical Society occupied rooms in the same building. Dr. Thomas Ives Parker also had an office there at the same time. A picture of the building at this time would be most valuable, but as this part of the street was widened in 1838, the old fronts were, of course, removed. The only pictures available were made after the alterations above mentioned. Any account of the interior arrangements of the building, the rooms used for teaching, and any data about the school at that time would be greatly appreciated. Such accounts are often found in old letters or family papers; and any facts, no matter how small or insignificant, will be of great help in working up the history of the school at this period. The writer would appreciate having any data sent to him at the Harvard Medical School, Longwood Avenue, Boston. With many thanks for inserting this letter in the JOURNAL, believe me,

Very truly yours,

JOHN WARREN.

CONTRIBUTION TO THE STUDY OF CANCER.

Sorel, P. Q., March 20, 1919.

Mr. Editor:

Should not the growth known as "cancer," the earliest apparent manifestation of the cancer disease, be considered the point of lowered resistance of the body, a point where nature brings together all her forces for defense, as she does in the case of trivial abscesses.

Do the facts not show clearly that the so-called "cancer" is but a "field cleared of all plants, where an unnatural fight is taking place, where nature appeals from the resistance elsewhere, where nature proliferates, where nature tries the recovery of vegetation after a loss?" (Sainte-Marie)

We generally acknowledge that cancer is subject to repeated irritations,—irritations which are the cause of *minor resistentia* everywhere and are followed by growth locally. We generally acknowledge that cancer is a proliferation of tissue cells forming a growth,—a growth, the effect of proliferation or an act of nature's defense, the concentration of energies brought from the body elsewhere—detrimental to it—for the recovery of that part.

Are there any symptoms accompanying cancers generally that strengthen this theory? We are inclined to answer in the affirmative. In the first place, lack of resistance is a condition accompanying old age and not youth. This we know. Cancer also is a condition of old age, *i.e.*, of those who have lost their resistance.

Second, atony of the arteries is very common in cancerous conditions, a fact that can be controlled *de visu* very often as in the case of (1) red streaks in some parts of the body, but more commonly on the nose, the cheeks, the dorsal surface of the hands; (2) a streptococcal poisoning appearance of the vessels of the fauces and of the pillars; and (3) according to recent investigations, the alveolitis dentalis or pyorrhea alveolaris, the disease *par excellence* of diseases of *minor resistentia.*

Third, the lack of resistance is apparent again in defects of metabolism, noticed in many cases of cancer. Many patients appear at clinics auto-intoxicated. A great number have not masticated their food for years past, have not salivated it, have eaten too fast, have drunk before mixing their food with their saliva. have smoked too intensively, and have eaten without any discrimination, at any time, many or all kinds of foods. It is no wonder that these things decrease resistance, both physiologically and pathologically.

Are not all these facts corroborating the assertion that possibly the origin of cancer may be in a concentration of nature's defense, in a focus of *minor resistentia* determined by auto-intoxication or intoxication of some kind.

If this is the case, there should be medical treatment of cancer so as to increase the powers of human resistance (gums, iodine, ichthyol appropriated for assimilation; agents of reconstruction, as possibly arsenical preparations with astringents) and there should be a hygienic method of treatment directed toward proper drinking and eating.

PHILIPPE SAINTE-MARIE, M.D.

SOCIETY NOTICES.

SUFFOLK DISTRICT MEDICAL SOCIETY.—The annual meeting of the Suffolk District Medical Society will be held April 30, 8.15 P.M, at the Boston Medical Library, 8 The Fenway.

Speakers:

Dr. David L. Edsall. "Some Relations of the Practitioner to Industrial Medicine."

Dr. Cecil K. Drinker. "An Unusual Type of Metallic Poisoning."

J. BAPST BLAKE, M.D., *President.*
GEORGE R. MINOT, M.D., *Secretary.*